PRINCIPLES AND METHODS OF STEAM STERILIZATION

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Terminal Learning Objective

- Given a gravity displacement, pre-vacuum, high pressure, and /or washer-sterilizer, and the necessary equipment and supplies, sterilize medical equipment and necessary supplies, in maintained sterilizers IAW cited references.

Enabling Learning Objectives

- a. Given a list of terms and definitions, match the correct definition with each term IAW Operating Room Technique.
- b. Given a list, select the disadvantages and advantages of steam sterilization IAW Operating Room Technique .

Enabling Learning Objectives (cont).

- c. Given The appropriate information be able to identify the differences and functions of steam sterilization, IAW Operating Room Techniques and FM 8-38.
- d. Given a list, identify the parts of steam sterilizers IAW Operating Room Technique.

Enabling Learning Objectives (cont).

- e. From a list of maintenance procedures, select the correct procedure for performing daily and weekly steam sterilizer maintenance, IAW FM 8-38
- f. Given a list of sterility test controls, select the sterility controls of steam sterilizers, IAW Operating Room Technique, and FM 8-38.

Enabling Learning Objectives (cont)

- g. Given a list, identify grouping and loading of items to be sterilized, IAW FM 8-38 and Operating Room Technique.
- h. Given a list, select the appropriate procedure for loading a steam sterilizer, IAW FM 8-38 and Operating Room Technique.
- i. Given a list, select the control setting for a steam sterilizer IAW FM 8-38 and Operating Room Technique.

ENABLING LEARNING OBJECTIVES (CONT)

- J. Given guidelines, perform drying, cooling, and unloading of sterilized items IAW FM 8-38 and Operating Room Techniques.

Terminology

- Autoclave- An apparatus for sterilization by steam under pressure, usually at temperatures of 250 degrees to 270 degrees F.
- Bacillus Stearothermophilus- a highly resistant but relatively harmless nonpathogenic microorganism used to challenge steam and dry heat sterilizers.

Terminology (cont).

- Bioburden- The degree of contamination with microorganisms and organic parameters
- Bioresistance- Factors such as heat and/or moisture sensitivities and product stability.
- Biostate- The nutritional, physical, and reproductive phase of microorganisms.

TERMINOLOGY (CONT)

- Bioshielding- Characteristics of the packaging materials.
- Bowie Dick test (DART)- A test run daily that validates the vacuum function of the sterilizer. The test should be run in an empty load at the same time every day.
- Contaminate- To render unfit for use through introduction of a substance which is harmful or injurious.

TERMINOLOGY (CONT)

- Contamination- A state of being soiled or infected by contact with infectious materials.
- Culture- A growth of microorganisms on a medium.
- Culture Medium- Any substance or preparation used for the growth and cultivation of microorganisms.

TERMINOLOGY (CONT)

- Density- Degree of compactness;closely set or thickness.
- Incubate- To maintain under optimum environmental conditions that are favorable for growth.
- Incubation period- The period between the time infection occurs and the appearance of the first symptoms.

TERMINOLOGY (CONT)

- Incubator- an Apparatus for maintaining a constant and suitable temperatures for the growth and cultivation of microorganisms.
- Nonpathogenic- Not capable of producing disease.
- Pathogenic- Capable of producing disease.

TERMINOLOGY (CONT)

Spore- Certain microorganisms which are capable of forming a thick wall around themselves enabling them to survive in adverse conditions; resistance form of bacterium;reproductive cell in lower plants. It is highly resistant to heat.

- Sterile- Completely devoid of all living microorganisms.

TERMINOLOGY (CONT)

- Sterilization- A process by which all forms of microbial life including bacteria, viruses, spores and fungi are completely destroyed.
- Thermal equilibrium- A condition where all parts of a system have reached the same temperature;in a steam autoclave, when the temperature throughout the entire load is the same.
- Wicking- A strike –through the package. A wet spot or any foreign material on package.

Disadvantages of Steam Sterilization

- Preparing, packaging,loading and operating the sterilizer. Also, drying time.
- Instruments need to be free from grease and oil and not be sensitive with heat.
- All items must have direct contact with steam and must be able to penetrate packaging material.
- Timing is adjusted for the differences in load and material and subject to human error.

Disadvantages of Steam Sterilization

- The steam may not be pure. Refers to the amount of solid, vapor, or liquid contamination in the steam.

Advantages of Steam Sterilization

Easiest, safest, and surest method of on-site sterilization.

- Fastest method, total cycle time is shortest.
- Least expensive and most easily supplied agent-piped in from the facility's boiler room.
- Most sterilizers have automatic controls and recording devices to eliminate human error from the process

Advantages of Steam Sterilization

- Stainless steel instruments withstand repeated processing without damage and no residue.
- Steam kills at lower temperatures than dry heat.

Types of Steam Sterilizers

1. Gravity displacement.

   a. Definition: Gravity pushes air through the packages and down through the drain. Sterilization begins when steam passes the thermometer and reaches the desired temperature.

Gravity Displacement

- Settings:
  - Temperature- 250 degrees F. to 254 Degrees F.
  - Pressure- 15 to 17 pounds per square inch(PSI)
  - Exposure time- 30 minutes for wrapped instruments. Minimum 15 minutes.

Gravity Displacement Uses

1. Metal ware
2. Glassware
3. Thermoplastics.
4. Linens.
5. Rubber.

Pre-vacuum (high temperature) Sterilizer

Definition: Air is completely evacuated from the chamber by a vacuum. The steam-injector helps eliminate the air out of packages. Steam then penetrates the packages on all surfaces.

Pre-vacuum

Settings:

1. Temperature: 270 degrees F. to 276 degrees F.

2. Pressure: 27 PSI

3. Exposure Time: 15 to 30 minutes.

Pre-vacuum Sterilizer

Uses.

- Metalware
- Rubber
- Thermoplastics

High Pressure (flash) Sterilizer

Definition: Another sterilizer that can be used in either gravity displacement or pre-vacuum. Gravity displacement is the most common used. Steam in the jacket should be maintained at all times.

High Pressure(Flash) Sterilizer

- Settings:
  - Temperature:
    - 270 degrees F. at sea level
    - 275 degrees F. 5,000 feet above sea level.

High Pressure(Flash) Sterilizer

- Settings Cont.:
  - Pressure:
    - 27 PSI at sea level
    - 22PSI at 5,000 feet above sea level.
  - Exposure Time:
    - 3 Minutes for unwrapped, non porous items without lumens.
    - 4 minutes with pre-vacuum cycle.
    - 10 minutes gravity displacement cycle.

High Pressure Flash (cont)

c. Uses--Urgent items. (dropped items for which no method of sterilization exists) Items that are dropped, or forgotten.

Washer-sterilizer

Definition: Wash and sterilize instruments. The unit is usually located in Decon of CMS. The water floods the chamber with cold water to prevent proteins from setting on the instrument. The water is then heated with steam to agitate and clean the instruments.

Washer -Sterilizer

- Temperature: 270 degrees F
- Pressure: 28-32 PSI
- Exposure time: 12 Minutes

Washer-sterilizer (cont)

Use-- to wash and terminally sterilize items which are non-heat sensitive, immediately after operative procedures.

NO GLASS, SHARPS OR DELICATE INSTRUMENTS GO THROUGH THIS STERILIZER. BREAKAGE COULD OCCUR!!!

Construction of Steam Sterilizers

Steam Jacket: Surrounds the inner chamber and stores steam until pressure has been obtained.

Inner Chamber: Items to be sterilized are loaded into this compartment without touching.

Construction of Steam Sterilizers

- Valves:
  - Pressure regulating: Maintains the pressure of 15 to 20 psi in the jacket.
  - Safety Valve: Prevents excess pressure build-up.
  - Steam trap: If pressure to high, valve opens and releases pressure.

Construction of Steam Sterilizers

- Gauges:
  - Located on front of sterilizer.
  - Reading chamber pressure
  - Reading Jacket pressure.

  Safety Steam-lock Door:

  Located in front of chamber

  Weakest part of sterilizer

Construction of Steam Sterilizer

- Return Line trap: Receives the discharge of condensed moisture from the jacket.
- Bristol graph chart: Records time, temperature, and exposure.

Maintenance of Sterilizer

When the sterilizer is cool, remove strainer and clean lint and sediment from the pores with a stiff brush.

Clean Inner Walls:

Use mild detergent and rinse chamber completely before use.

Never use abrasives, use steel wool to clean the chamber with. Ensure chamber is dry before starting load.

Clean outside with mild detergent and water.

Maintenance Cont..

- Daily cont:

- Recording Chart:
  - Charts are to be replaced daily and stored for record keeping.
  - Pens must be lint free and in operating order.

Weekly Maintenance

Wash all equipment used inside sterilizer such as baskets and trays.

Remove strainer and flush drain line with One ounce of Trisodium Phosphate and one quart of hot water.

Check door gasket for signs of wear and tear.

Inspect pitch of chamber: take small amount of water and place in center of chamber. It should roll to the drain.

Sterilizer Test Controls

Chemical indicator controls.

Heat sensitive tape: The stripes turn black after sterilized to indicate that the item has been exposed to the sterilization process.

Indicators-OK: Placed in densest portion of the pack and the strip turns black. The “K” of OK should be black.

Biological Indicator Controls/Spore Tests

Bacillus Stearothermophilus:is used strictly for Steam and dry heat sterilizers.

Tests ability of sterilizer to kill microorganisms.

Biological Indicator Control/Spore Tests (cont)

When Used:

- Upon installation of new system
- After major repairs
- Routine quality assurance. Preferably daily if use sterilizer.
- With all implants

Biological Indicator

- Must be incubated:
  - Follow manufacturers instructions
  - Use correct temperature 131-140 degrees F.
  - Use special incubator
  - Incubate for 48 hours or follow manufacturers instructions

Biological Indicator

- Record results:
  - Negative- no color change from original.
  - Positive- color changed is usually amber in color.
    - Take sterilizer out of service
    - Report to supervisor
    - Recall all items sterilized in sterilizer for last 24 hour period

Bowie-Dick/Dart Tests

Monitors air removal.

Monitors air leaks in chamber.

Prevacuum sterilizers only.

Conducted before first load.

Bowie Dick Test

Test sheets must have consistent color change throughout entire sheet.

If test shows evidence of a air-pocket, report to supervisor immediately and do not use the sterilizer.

Grouping of Items

- Items are grouped according to time, temperature, cycle and type of sterilizer.
- Gravity Displacement: Double wrapped basin, prep, instruments sets, linens, sponges and so forth are grouped together for the sterilization cart.
- Prevacuum: The same as listed before.

Loading The Sterilizer

- Select perforated metal cart
- Arrange all like items to provide least resistance to air.
- Turn all packs on their side with the opening pointed downward
- Large packs- only one layer

Loading Cont…

- Allow air space between packs with light touching. DO not try and squeeze one in.
- Place smaller packages on top and crisscross if needed.
- Place peel packs in wire basket and place on top with small packages.

Loading cont…

- Maximum sized package is 12”X 12”X 20” and 12 lbs. Density of 7.2 cubic feet.

- Place test packs on the bottom shelf of the chamber near the drain.

Control Settings

- Timer is set to required number of minutes
- Set the temperature to required settings
- Set drying time to 20 minutes or follow local SOP

Controls Cont…

Gravity Displacement with cart:

- Items sterilized for 15 minutes at 250to 254 degrees F. with 15 to 17 psi.

Gravity Displacement without cart:

Items are sterilized for 20 minutes at 250 degrees. Excluding any tubing items.

Controls Cont…

- Pre-vacuum:
  - 4-5 minutes at 270-276 degrees F. at 27 ISBN 0-9670222-8-2

Drying and Cooling

- Open door when pressure in chamber is zero.
- Handle items as little as possible.
- Allow them to cool and dry before putting plastic on.

Drying and Cooling Cont. . .

- Record temperature attained and length of cycle
- Visually inspect sterilization tape
- Check Bristol graph and file
- Let cool for at least 15 minutes
- Date packages and store. Record in log book

Steam Sterilization

Questions????